Progress Report
Quantitative Investigation of the Mineralogy and Petrography of the Iron Meteorites
Project No. NsG-439

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STAFF: Staff during the period consisted of E. N. Cameron, Principal Investigator, and A. R. Ramsden, Project Associate. Cameron's work was part-time and limited. Ramsden spent full time on the project.

Work accomplished:

(1) A paper entitled "Kamacite and Taenite Superstructures and a Metastable Tetragonal Phase in Iron Meteorites" was completed and submitted for publication in the American Mineralogist. Acceptance has subsequently been indicated.

(2) Determination of reflectivity curves for synthetic Fe-Ni alloys was completed. Comparison of values for synthetic alloys with those for kamacite and taenite is in progress. Descrepancies have appeared, and these are being investigated to determine whether they are related to the occurrence of the superstructures described in the paper cited above.

(3) Modal analyses of kamacite/taenite ratios have been extended to ten iron meteorites. A systematic relation between kamacite/taenite ratios and bulk Ni contents of meteorites is indicated. An attempt is being made to apply these data to determining temperatures of formation of iron meteorites and as a check on the applicability of the 1-atmosphere vs. the high-pressure phase diagram of the system Fe-Ni.

(4) Quantitative size analyses of kamacites in ten iron meteorites indicate that lamellae widths fall into sets separated by breaks. Various meteorites studied have 3 to 5 size sets of lamellae. In a given meteorite the sets range from earliest and coarsest to finest and latest. The size progression is therefore also a time progression. The data indicate that kamacite separation is marked by successive stages of undercooling, each terminating in a precipitation stage. The decrease in size from one stage of precipitation to the next is in accord with current estimates of the change in diffusion rates in the gamma phase with temperature. This work promises to shed light on thermal histories of iron meteorites.

(5) Some further work on reflectivities of cohenite and troilite has been done.

Work in progress:

(1) Highest priority is being given to completing the work on reflectivities of kamacite and taenite. For this purpose, compositions of Km and Tn for which R data are obtained are being

ascertained. This involves electron probe analysis, which are being done at the National Museum. Probe analyses for a series of kamacites are now at hand. Analyses of taenites are next. In assembling data for R of kamacites and taenites, the effects of superstructures and chemical polishing must be evaluated. This is in progress.

(2) Quantitative modal analysis of iron meteorites is being continued, for kamacite versus taenite over the full range of bulk Ni compositions, and for contents of accessory minerals in the metal phase.

(3) Textural relations of cohenite, graphite, schreibersite and troilite are under study in selected meteorites.

(4) Quantitative size analyses are to be made for kamacite in additional meteorites.

(5) Optical constants for cohenite, schreibersite, daubreelite, troilite, and pyrrhotite are to be finally determined.

(6) Equipment for exploring reflectivites in the near infra-red is being assembled.

Madison, Wisconsin
October 1, 1965